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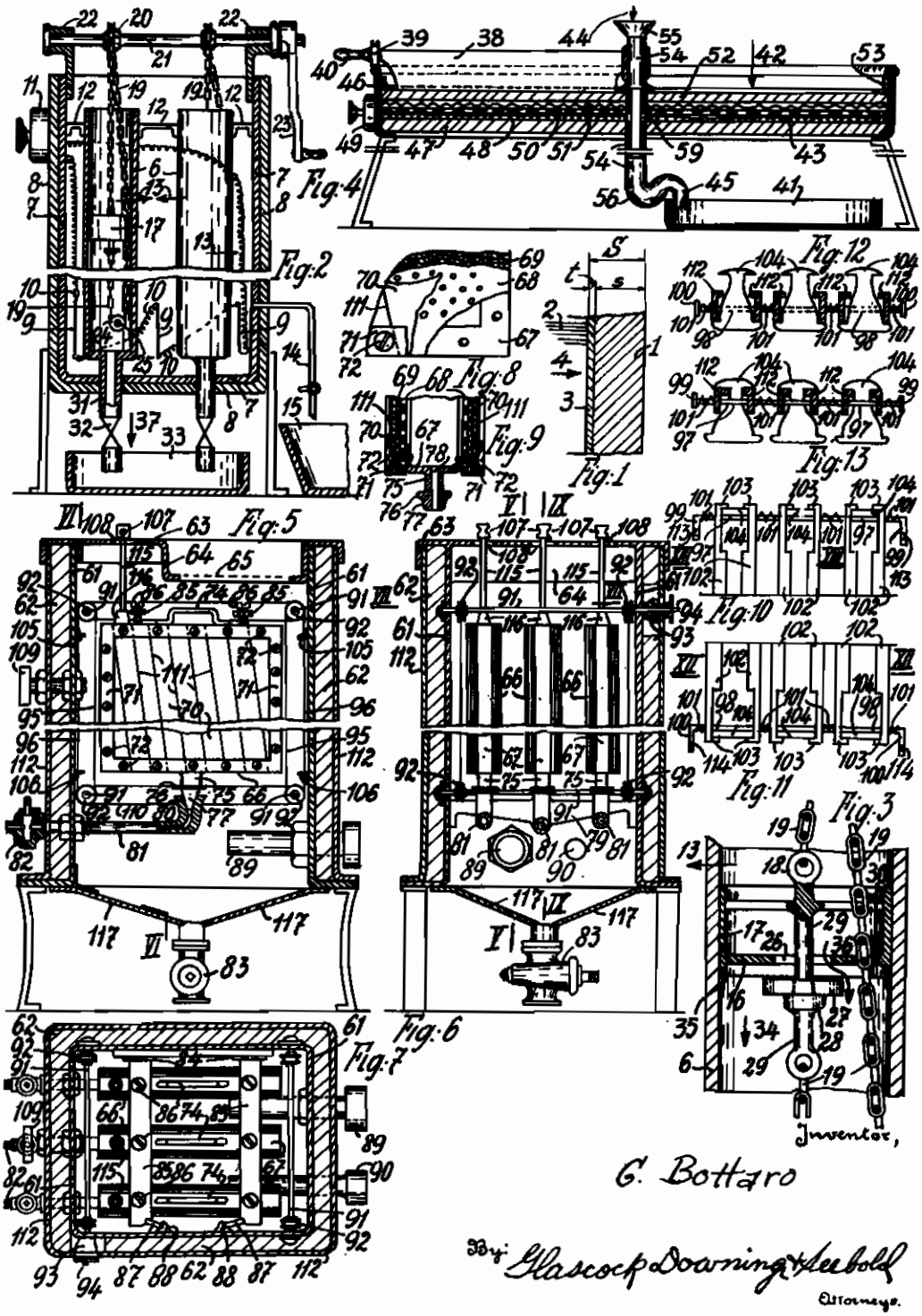

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PROCESS AND APPARATUS FOR THE RECLAIMING OF USED LUBRICATING OILS

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It is known that it is sufficient to separate from used lubricating oils the insoluble oxidation products and other mixed impurities, so as to render them again ready for use.

This reclaiming is made a great deal through a filtration or by means of centrifugals and the results thus obtained are useful up to a certain grade. The filtration gives better results but it is rendered difficult on account of the semisolid or colloidally dissolved oxidation products or highly dispersed carbon, and therefore one is obliged to make use, in order to be able to achieve such filtration, of filter aids such as fullerearth, asbestos-fiber or asbestos-powder, sawdust and the like in order to make the filtration possible. Of course these filter-aids adsorb also the oil which is therefore partially lost.

It has now been found that better results with a higher yield and in a much more simple way can be obtained if the used lubricating oils are submitted to a sweating process. In this way the impurities and the semisolid oxidation products are removed even better as through the use of filter-aids, while the apparatus for the putting into practice of the process are so simple that they can be actioned semi or fully automatically with a total saving of assistance and labour.

The present invention refers to this sweating process for used oils as well as to the means and apparatus which allow this sweating process to be put into practice.

To this purpose the used oil is put into devices of different construction which contain special separation elements, the porous surfaces of which possess the property to adsorb and to retain firmly the semisolid axidation products, the so-called "asphalts". The coating that forms itself on the surface adheres so closely to them that same cannot be removed by mechanical means. In this way an actual compound is formed between the "asphalts" and the surface of the porous wall which form together a diaphragm which has the property to function as a skin, so that the bright oil is first absorbed by said diaphragm and proceeds further into the inside of the porous wall, wherefrom it runs out in the open. All impurities, as for instance, colloidal coal, dust and other quantities of asphalt are caught by the asphalt-porous-surface-diaphragm, which adsorbs also in all likelihood substances which are dissolved colloidally in the oil, the so-called oilrosins, at least those which possess a high molecular weight.

When the diaphragm is formed and when no pressure is used on same, it impedes also that the asphalt proceeds further into the inside of the porous wall, so that the sweating goes through a relatively attenuated layer of asphalt combined with the surface the porous wall.

This diaphragm has also the property to break the oil-in-water emulsions and the greater quantity of the water is also kept back while a part of the disemulsioned water can pass through the diaphragm. Therefore the action of this diaphragm can be compared completely with that of a skin and the process to the phenomenon of a sweating. A pressure or a vacuum do not help in the case; on the contrary, as already said, the diaphragm is damaged because it becomes thicker on account of the fact that the asphalt particles run deeper into the porous wall with the result that the sweating is rendered more difficult, because the bright oil has to run a longer way through the diaphragm. As indicated by these facts, the process is totally different from a filtration and therefore same has been called for reasons of analogy and to indicate its purpose "sweating process".

The materials which form the porous surfaces are those which have an adsorption property towards the so-called asphalt or show in any way a property of attraction for it. This phenomenon is probably based on the existence of electrical charges having opposite signs. The materials that come into consideration are the following: tissues of asbestos, of glass, of nitrated or acetylated cellulose and as last: vegetable fibers. Also porous stones can be used. Wool or animal hair cannot be employed for the purpose. Asbestos qualities best and in the present description only the term "asbestos" is going to be used, which will comprise also all other materials suitable for the sweating process. Tissues of asbestos or glass are preferred because same are chemically inert and have a very long duration, so that the porous walls may last for years without need of changes.

The process presents the utmost important advantage that the sweating surfaces do not require to be changed, and therefore the apparatus in which they are disposed shall never be opened and are allowed to work continuously, with the only proviso that used oil is fed without interruption and that the excess of impurities separated on said surface is removed from time to time. As we shall see hereinafter, the apparatus are constructed correspondingly in order to remove substances without the necessity of opening the apparatus or to interrupt the sweating process.

These apparatus can also be built following the

known constructive forms of filtration apparatus, but as already said, it is the purpose of the present invention to indicate new forms of construction which allow to realize the following advantages:

1°—the fact that the sweating surfaces never need to be changed;

2°—the fact that the apparatus can work without any interruption with no need of opening them and stopping therewith the reclaiming process;

3°—the fact that there is no need for assistance and labour for the working of the apparatus.

In the annexed drawings the principle is illustrated and herewith only by way of example a few forms of construction of apparatus for the realisation of the present invention are presented.

Fig. 1 represents a vertical section of part of a sweating element where the separated layer of asphalt can be noticed.

Fig. 2 represents a schematical vertical section of an apparatus showing two sweating candles.

Fig. 3 represents on a larger scale a vertical section of a part of a candle, together with a special device pertaining to the candle. This section is carried perpendicularly to the section of Fig. 2.

Fig. 4 represents a vertical section of another device which serves to realize the process concerning the present invention.

Figures 5 and 6 show two vertical opposite sections (V—V of Fig. 6 and VI—VI of Fig. 5) of the upper and inferior part of another device pertaining to the invention.

Fig. 7 shows an horizontal section (VII—VII of Figures 5 and 6; in Figures 5 to 7 several details are left out for the sake of clearness.

Figures 8 and 9 show on a larger scale the shape of an element of the device following Figures 5 to 7, sidewise and on a sectional view (IX—IX of Fig. 6).

Figures 10 and 11 represent on a ground-plan respectively the cleaning elements when working and when at rest.

Figures 12 and 13 show on a vertical section (XII—XII of Fig. 11 and XIII—XIII of Fig. 10) said cleaning elements and means to remove them from, or to approach them to the sweating surfaces.

With special regard to Fig. 1, represents 1 the porous medium having a thickness s, 2 the used oil to be sweated, 3 the compounded layer of asphalt having a thickness t; the sweating unit in therefore formed by the combination of sweating diaphragm 3, its support 1, said unit having therefore a thickness $S=s+t$.

The layer 3 is formed at the beginning of the process. When this layer is formed and a new particle of the used oil comes into contact with a point of layer 3 in the direction of the arrow 4, the layer 3 absorbs first the bright oil and cedes it further to the porous wall; as already said the porous wall 1 possesses a property of adsorption for the substances which form layer 3, so that these substances cannot penetrate the porous wall 1 if no pressure or vacuum is applied.

As can be seen, the side 5 of the porous wall 1, from which the bright oil comes out, is so shaped that the oil can flow with no hindrance. In this way it is excluded that the sweated oil may exercise a reaction which could prevent or render more difficult the normal course of the sweating. The porous wall 1, as said before, can be made of asbestos or glass tissues or out of porous stones or tissues of vegetable fibers.

Following the viscosity and the nature of the sweating oils, a more or less energetic heating of the used oils is provided for.

The apparatus of Fig. 2 contains two candles 6 which are inside of a tank 7, which is isolated through an insulating medium 8. In the inside of tank 7 electrical resistances 9 connected with an electrical circuit 10 are placed; 11 is a regulator for the electrical current, which is intended to keep the temperature inside of the apparatus at a determined degree. The used oil is fed in the inside of candles 6. These candles are kept on place through devices which are schematically indicated through 12.

The sweating process goes in the direction of arrows 13 through the sweating layers and through the walls of the candles 6, i. e. from the inside to the outside of said candles. In this way the impurities remain on the surface of the inside wall of the candles and the bright oil pours in drops out of the surface of the outer wall and falls in the tank 7 wherefrom it flows through the pipe 14 in the container 15.

The layer (3 of Fig. 1), constituted out of the impurities that in the case of Fig. 2 are depositing on the inside surfaces of the candles, gets always thicker and therewith the intensity of the sweating slows up. It is therefore necessary to remove the excess of these impurities whereby it is necessary to take care that a layer 3 of a certain thickness remains adherent on this inside wall.

To this purpose (Fig. 3) means are provided for, which are constituted principally of a piston 16—17—18, which has a cylindrical wall 17 and which is attached through the arms 18 and the shaft 29 to an endless chain 19, which runs over the pulley 20 carried by shaft 21 which is supported by the supports 22. The crank 23 provides for the motion of the parts just described. The chain 19 runs inferiorly over the pulley 24 which is adjusted in the inside of the candle and which is mounted on shaft 25.

The bottom 16 of the piston has a central opening 26, which can be closed by disk 27 which finds itself underneath and which is movable along the shaft 29. Disk 27 has a larger diameter than opening 28. The weight of disk 27 is so chosen to allow such an operation as described further below. Disk 27 rests on ring 28 on shaft 29. That part of the chain 19 which runs from the lower pulley 24 to the upper pulley 20 goes through another opening 30, which is provided at the bottom 16 of the piston.

The lower end of each candle terminates in a pipe 31, which carries the valve 32 through which the separated impurities fall out in the container 33.

The operation of the device following Fig. 2 and 3 is as follows:

Piston 16—17—18 rests usually at the upper end of the candle; disk 27 rests on ring 28, the opening 26 is free; the used oil is allowed to flow in the direction of the arrow 36 towards the bottom of the candle. When the excess of the deposited impurities on the inside of the wall of the candle must be removed, piston 16—17—18 is pushed by means of crank 23 and endless chain 19 towards the bottom of the candle in the direction of arrow 34 in a way that the lower edge 35 of the piston-wall 17 removes mechanically said excess through a scraping action. The impurities are pushed by means of wall 16 towards the bottom of the candle while the oil flows through opening 26 of the bottom 16 of

the piston in the opposite direction of the arrow 36. Disk 27 during this motion remains on account of its own weight resting on ring 28. When there is no more oil under the bottom 16 of the piston, but only a body of semisolid impurities, disk 27 is pushed upwards and closes the opening 26, so that the impurities are compelled downwards. In this way and through the opening of the valve 32 the body of impurities is pushed through the pipe 31 in the direction of the arrow 37 out of the apparatus. When piston 16—17—18 arrives at the bottom of the candle, crank 23 is turned in the opposite direction and therewith the piston 16—17—18 goes upwards in the opposite direction of the arrow 34 and therewith opening 26 of the bottom of the piston 16 is free again.

Fig. 4 represents a simpler construction of an apparatus following the same sweating principle and is employed there where small quantities of oil come into consideration. The device according Fig. 4, is composed principally of a container 46 at the bottom of which there is an insulating layer 47, on which an electrical resistance 48 is applied, which is regulated through the thermostat 49; on this resistance is adapted a diaphragm 50 which is made of a perforated metallic surface on which a metallnet 51 is adjusted. Below the perforated plate 50 another metallnet 51 can be placed. The metallnet 51 is covered by the porous wall 52 which is kept on place by the ring 53. A pipe 54 which is funnel-shaped at 55 at its upper end runs through all said parts and terminates below with a siphon 56, the opening 45 of which is placed above the container 41. The pipe 54 is perforated in correspondence to the empty space below diaphragm 50 by several holes 59 which allow the bright oil to run out; electrical heating may be replaced by a water-bath.

The used oil is first fed in the direction of arrow 42 in the container 46 and a certain quantity of the bright oil in the direction of arrow 44 in the funnel 55 of pipe 54 in order to load the siphon. The very light suction of pipe 54 permits a rapid outflow of the bright oil from the space 43. Means 38 for the removal of the exceeding portion of the separated impurities are shown at 36 as pivoted on the tube 54 supported by means of the roller 39 on the border of the container 46 and compelled to turn by means of a handle 40 or the like.

With reference to the construction as shown in the Figures 5 to 13 it is to be observed that the device for the application of the sweating process is composed by a number of elements 66 which are contained in a tank 61 which is insulated by a layer of insulating material 62; the cover 63 in the form of a plate presenting a container 64 has at its bottom a perforated metallic plate or net 65, for the retention of the coarsser impurities when oil is fed in the apparatus; the used oil goes through the net 65 and fills the inside of the tank 61 and comes into contact with the active surfaces of the sweating elements 66.

Each of said elements (Figures 8 and 9) are composed of a rectangular frame 67 made out of C-structural iron which limits two opposite flat surfaces on which are successively adjusted the following pieces: a perforated plate 68, a metal net 69 and a piece of cloth 70 made of asbestos or of some of the other aforesaid materials. Wires 111 lay at the outer surface of cloth 70. These wires are very thin and are made with metal having a high tensile strength. A frame 71 fixes all aforesaid pieces and same is kept on place by the screws 72 which are fastened in the holes 73 on said frame 67. Each frame has at the bottom and in the middle a pipe 75 which ends with a shoulder 76 and a frustro-conical projection 77, both of which are perforated by the canal 78; the frames have in their upper part a handle 74.

A cross-beam 79 (Fig. 6) which is fastened at the opposite walls of the container 61 carries frustro-conical seats 80 the shapes of which correspond to the frustro-conical projections 77, as shown in Fig. 5. A pipe 81 which goes through the walls 61 and 112 of the apparatus is connected with each of said seats 80 and is closed by a cock 82, so that to each sweating element corresponds a cock 82.

Cross-beams 85 (only shown in Figures 5 and 7) are fixed on hinges 84 (which are shown only in Fig. 7); said cross-beams carry the pressure screws 86 (only shown in Figures 5 and 7) which act upon the upper edge of frame 66; 87 represents (Fig. 7) fasteners which are movable around 88 and serve to fasten the cross-beams 85 on their place, or to allow to lift them for taking out or fixing the elements 66; 89 is a device which serves to heat the used oil and 90 is a thermostat which keeps at a determined temperature apparatus 89. The working of the described parts of the apparatus is as follows:

The used oil is fed in the container 64, the coarser impurities are retained on net 65, and the rest of the oil flows downwards, fills tank 61 and comes into contact with the cloth 70 which corresponds to wall 1 shown on Fig. 1 at the outer surface of the cloth or plate 70 is formed a layer which corresponds to layer 3 of Fig. 1. The bright oil enters in the inside of the elements 66, which process is allowed by the presence of the net 69 and of the perforated plate 68 (as happens in the pieces 51 and 50 of Fig. 4). The separated impurities remain attached on the sweating surface 70 and accumulates (as will be shown hereinafter) at the bottom of the tank 61, wherefrom they are removed by opening from time to time the valve 63, the bright oil flows out through the cocks 82; if one of the elements 66 for some reasons or other runs cloudy, it is sufficient to close the corresponding cock 82. On the sweating surface 70 accumulates also a layer of deposit and when the thickness of same is too great, a part of it is removed as indicated hereinafter.

For this purpose the apparatus of Figures 5 to 13 besides the aforesaid metal wires 111, is provided with cross-shafts 91 which are turnable and are pivoted on wall 61, and one of which comes out through packing 93 from the wall 112 and ends with the square head 94. At the ends of the cross-shafts 91 are adjusted the little pulleys 92. A chain is vertically mounted on said pulleys 92; another chain 110 is mounted horizontally below. Said chains are stretched by means of a swivel of known construction and which are not shown. The inward branch of the vertically disposed chains are represented in Fig. 5 with 95 and the outer branch with 96. On each side of an element 66, facing with the exterior surface of a sweating plate 70 a means is provided for the scraping of said exterior surface of the sweating plate 70 and same is working on wires 111. Said scraping means 102 can take either the close position, as shown in Figures 10 and 13, or can

take the spaced position as shown in Figs. 11 and 12.

The Figures 10 and 11 show these scraping means 102 and their supports as if they were separated from the apparatus, but it is necessary to understand that between two scraping means either in close or spaced position an element 66 is always comprised.

Each of said scraping means 102 possesses at both ends a hole through which passes the cross-rod 97 at one end or the cross-rod 98 at the other end; the ends of cross-rods 97 and 98 are provided with projections 99 respectively 100, which are disposed horizontally, same as the edge of the scraping means 102, and carry at their ends means, for instance a little hole 113 respectively 114, by means of which they are attached respectively to said chain-branches 95 and 96. The ends with hole 113 are for instance attached with branches 95 (left on Fig. 5), and the ends with hole 114 are connected with branch 96 (right on Fig. 5). A chain or another suitable mean 110 (Fig. 5) connects the rod 91 at one side of the apparatus with rod 91 at the other side, so that when the square head 94 is turned, the rods 91 on one side turn in the opposite sense to the rods 91 placed at the opposite side and therefore the chain-branch 95 (left on Fig. 5) moves in the same direction as the chain-branch 96 (right on Fig. 5). Therewith the scraping means 102 are moved downwards or upwards uniformly. Springs 101 are provided between the projections 99 and 100 and the ends of the contiguous scraping means 102 and also between the ends of the scraping means 102 placed at sides of each element 66. Said springs serve to press the scraping means 102 towards the sweating surface of the plates 70.

The scraping means 102 end at their outer side with bent portions 103 and between them and the cross rods 97 respectively 98 are placed driving members 104 which may remove the scraping means 102 from the sweating surface of the plates 70; these driving members can take by means of the abutment members 105 and 106 the lowered position shown in Figures 10 and 13 or the raised position shown in Figures 11 and 12 and therewith the scraping means 102 are obliged to assume respectively close position shown in Figures 10 and 13 or spaced position shown in Figures 11 and 12.

The way of working of the device is as follows:

During the working of the apparatus the scraping means 102 lay below in spaced position (Figures 11 and 12) while the driving members 104 with their lower edges, which lay on the abutment members 105, have taken the position shown in Figures 11 and 12.

When an excess of impurities has accumulated on the exterior surfaces of the sweating plates 70 and it is necessary to remove a part of them, in a way so as to allow that only the thin layer, as indicated with 3 in Fig. 1 remains attached to them, the group of the scraping means 102 are moved upwards by means of a rotation of the squarehead 94, while the active edges of the scraping means 102 are at a certain distance from the surface of the sweating plates 70 (i. e. in the position shown in Figures 11 and 12); this rotation is continued so long till the upper edges of the distancing means 104 come into contact with upper abutment members 106, which are put on the vertical path of said means 104. When this happens the distancing means 104 cannot move any further while the cross-rods 97 and 98 and the scraping means 102 can still continue this upward motion till they reach the position as shown in Fig. 13. In this moment through the action of the springs 101 the scraping means 102 take the position shown in Figures 10 and 13 in which the scraping edges come into contact and press the metal wires 111 which lay on the exterior surface of the sweating plate 70. When now the squarehead 94 is made to rotate in the opposite direction, the group of the scraping means 102 runs downwards pressing said wires 111, so that the surface of the sweating plate 70 is practically untouched and cannot then therefore be damaged, while the group of the scraping means 102 is caused to lower in the position shown in Figures 10 and 12. In this way the excess of deposited impurities is removed from the surface of the sweating plate 70 and falls downwards, while on said surface a layer of deposited material remains, which is of a thickness about equal to the diameter of the wires 111; when the distancing means 104 come into contact with the lower abutment member 105, the scraping means 102 go apart from each other and take again the position shown in Figures 11 and 13; if the first scraping should not be sufficient, the operation can be renewed; the scraped impurities are pushed downwards and drop out through valve 63.

In order to avoid that on account of the especially high resistance of the material, out of which the wires 111 are made of, they may with the time carve the active edges of the scraping means 102 while they work in position shown in Figures 10 and 13 (which scraping means 102 are made of a less resistant material), so that the thickness of the layer t (Fig. 1) on the surface of the sweating plate 78 may be reduced, the wires 111 (Figures 5 and 8) are adjusted on the sweating surface with a certain inclination from the perpendicular line, whereas the horizontal lying scraping means 102 are moving strictly perpendicularly and cannot therefore be carved in.

In order to avoid that there might be differences of pressure in the inside of each sweating element 66 on its upper portion by means of, threaded hubs 116 they are provided with an airvent 115 which goes through the hole 108 of the cover 83 and ends upwards with a head provided with holes 107.

109 is a thermometer which shows the temperature of the oil.

The above modes of construction are given only as examples, but a great many other can be employed in order to apply the fundamental principle of the present invention, as for instance when it is the question of treating materials for which similar conditions of work exist and which have a different nature as used oils.

For instance it is possible to immerse (Fig. 2) the electrical resistances 9 in the interior of the candles 6, each pipe 31 can work independently as shown in Fig. 2, or they may open into a common conveyor, which in its turn will have a sole outlet for the impurities of the complete apparatus.

It is also possible to have several containers 46 (Fig. 4) placed vertically one upon the other, which are then crossed by the same pipe 54. The sweating means could also be built following the mode of construction of the Kelly or Sweetland filter, or similar apparatus.

When the apparatus are of a larger size the

frustro-conical or pyramidal bottom 117 is replaced by a flat bottom which limits below the rectangular shape of the apparatus and is placed immediately underneath the resistance 89. The impurities assembled on this flat bottom are removed by scraping them longitudinally and have them fall for instance in a channel-shaped rotating discharger with an inferior longitudinal outlet incorporated in the device, or in a pyramidal shaped funnel placed at one side of the bottom wherefrom they can be withdrawn through a valve in the same manner as through valve 83.

A stream of steam may be blown countercurrently to the dripping oil by having it enter for instance through the sweated oil outlet so as said steam may flow in the inside of each sweating element going from the inferior to the superior part of same and coming out through the air-vents above.

Therewith two purposes are achieved:—firstly the heating of the apparatus, and—secondly the distillation of the fuel which may be contained in the oil.

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